M-CONTROLLER II
MONITOR AND CONTROL SYSTEM

INSTALLATION
OPERATION AND MAINTENANCE
MANUAL

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1 Glossary

Actuate/De-Actuate: These terms are used instead of 'make' and 'break' to allow us to distinguish between performing an action due to an environmental condition and whether the contact may be closed ('made') or open ('break') because of our use of double throw contacts, and the option of normally energized relays.

Averaging: When setting alarms, the alarm can be set to operate on the basis of the average signal assigned to that relay. It must be the same gas range.

Baud rate: A measure of the speed at which data is transferred over a digital communication link. Given as bit per second (bps). Generally the lower the speed, the more reliable.
bps: See Baud rate

Characteristic Impedance: The effects of capacitance and inductance of a pair of wires expressed as an equivalent resistance.

Configuration Database: System configuration requires entering a great deal of information concerning relay operation, sensor type and so on.

Dry Contacts: The relay contacts are supplied without power applied to any output terminal.

Normally Energized: The relay coil is energized in the non-alarm state. This is sometimes referred to as 'fail-safe' because in the case of controller failure or loss of power, the relay contacts will open.

Normally Open Contacts: In the non-alarm state, but under power, the contacts are open.

Latching: A relay once actuated remains actuated even though the condition has been removed. Requires a manual operation to reset.

RS-485 (properly EIA-485): A wiring and electrical standard for digital communication in a multi drop environment. It is a 2-wire system, with a differential signal allowing relative immunity to variations in grounds between devices. RS-485: maximum 32 transceivers per loop, 4000 ft (1300 meters) max. 120 ohm line termination required. (Line termination resistors are available on all M-Series devices via selectable jumpers).

Stub: A short wiring link branching from the main line.

Voting: When more than one sensor and setpoint is assigned to a relay, then voting defines how many must reach the setpoint before the relay actuates.

2 General System Overview

GES M-Series gas monitoring system is a set of remote sensors and relay control modules tied together and controlled by the M-Controller. GES sensor/transmitters comprise a group of remote mountable sensors complete with electronics, most of which have both analog and digital communications, and most of which have display and onboard relay options.

The M-Controller is a flexible programmable controller with capability to work with up to 32 GES digital sensor/transmitters and up to 8 analog (4-20 milliamps) linear input signals for a total of 40 sensors. With three on-board relays, the controller can also direct up to 12 remote relay modules (M-Relay, M-Annunciator etc.), each of which may have up to 8 relays. With the same RS-485 interface, the controller can also communicate with Remote Annunciator Panel (M-Annunciator and QRP) that are devices, located at some distance from the M-Controller and provides a user an audible and visual indication of the status of the M-Controller. The M-Controller also equips a USB port to allow traditional Windows PC software, M-View, to access the M-Controller config database. Additional RS-485 port can be programmed through Menu to either work as a Modbus RTU port for BAS or SCADA (as default) or work as a BACnet port to connect GES BAC-Box, which supports BACnet/IP protocol.

Additional features include relay outputs for strobe light and horn as well as an on-board buzzer. Two channels switch inputs are programmable to trigger any relays, buzzer, or any channel of Analog output.

The power supply is designed for 24VAC or 24VDC input power. GES can supply a transformer for external mounting sized to the application if requested.

NOTE:
WHEN PROGRAMMING THE M-CONTROLLER WITH A LAPTOP THROUGH USB PORT ENSURE THAT THE LAPTOP IS NOT CONNECTED TO ANY POWER SOURCE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT WITH DAMAGES TO THE CONTROLLER AND OTHER DEVICES CONNECTED TO IT.

3 M-Controller Specifications

NOTICE: Installing or using this equipment in a manner not specified by the manufacturer could cause electric shock, bodily injury, or risk of fire.

Specification:	
Power Supply	Voltage: 24VDC nominal, range 18 to 30VDC 24VAC nominal, range 15 to 24VAC 50/60HZ **Note: M-Controller II has full-wave rectifier and half-wave rectifier circuit on board for flexibility. You will damage devices if you mix half wave and full wave rectifiers on the same AC source. Use extreme caution when sharing a common AC source. Sharing a common DC source is less problematic.** Current: M-Controller: max. 1.0 A (fuse protected) Total actual power is dependent on the system design. The power may be supplied to sensors and modules, or each may have separate power supplies. Each type of sensor varies in its power requirements. **Note: No external overcurrent protection is required. Over-current protection is provided by means of fuses F1 and F2. See fuse specification below.**
Fuse	F1, F2 on Main Board: Polyswitch 750mA Polyswitch device resets after the fault is cleared and power to the circuit is removed.
Power Switch	Slide switch on circuit card (SW1). This switch disconnects power to the main circuit cards and LCD display. NOTICE: A switch or circuit breaker must be provided in the installation, which can remove power from the M-Controller in case of emergency or any other related requirement. Since the M-Controller enclosure can be locked to prevent unwanted tampering, the internal power switch is not guaranteed to be accessible.

	Feeding the M-Controller power from a rack main switch or from a switch in a distribution box is adequate.
Enclosure	NEMA 1, Steel, Epoxy painted black.
Environmental conditions	Location: Indoor use only Altitude: Up to 2 000 m Temperature: -10 °C to 50 °C Relative Humidity: 0 to 95% RH (non-condensing) Pollution Degree: 2, in accordance with IEC 664. Installation Categories (Overvoltage Categories) II
Display & Keypad	LCD display c/w backlight 6x tactile & audible keypad
Panel Indicators	10 Status LEDs Power Status RS-485 port TX/RX Status for Sensor Network RS-485 port TX/RX Status for Modbus LED1-LED5: RELAY1, RELAY2, RELAY3, HUSH, FAULT
On-Board Relays	3 Relays SPDT, Dry contacts, Relay1 to Relay3 Resistive load: 5.0A at 250VAC 5.0A at 30VDC Inductive load: 3.7A at 250VAC 3.7A at 30VDC
On-Board Switch Inputs: (BI)	2 channel switch inputs or binary inputs (BI-1 and BI-2) The switch can be Q-Switch or any ON-OFF switch.
Analog Input	8 channel 4-20mA Analog Inputs AI-CH1 to AI-CH8

On-Board Buzzer	Used for internal warning and alarm, 3700 Hz Continuous It's not used for Alarm-Sounding Appliance. For external Alarm-Sounding Appliance, they can be connected to the below Horn/Strobe terminal blocks, the Alarm-Sounding Appliance sound-pressure level should be at least 85dB at 10 feet according standard UL2017 Audibility Test
Horn & Strobe	Two relay dry contact are for Horn and Strobe Dedicated 24VDC terminals are supplied for connection to standard strobe and horn set. Strobe relay can be set to 50% duty of pulse or 100% duty ON Maximum of 750mA on the 24VDC power supply
Remote Devices	4x RS-485 Ports with GES Controller Protocol - Available GES digital transmitters, such as Q5C - Available I/O box: M-Relay, M-Annunciator, QRP
Modbus Slave Port **Or** **BACnet Port**	RS-485 port, default setting is for Modbus protocol _ Responds as a Modbus Slave using RTU protocol. M-Controller supplies read status information only _ Connect to GES BACnet/IP module BAC-Box The BACnet must be enabled in the BACnet MENU
Analog Output	Optional added circuit card to support 8 channels of 4-20 milliamps. The output signals and ground are isolated from the M-Controller.
Grounding	A protective conductor (earth wire) must be connected from the M-Controller grounding terminal to the electrical earth of the installation. A grounding point is provided inside the unit in the top right corner of the base of the enclosure. The protective conductor terminal is marked with the following symbol:
Certification	Standard UL 2017 2nd Edition 2008

4 M-Controller Installation

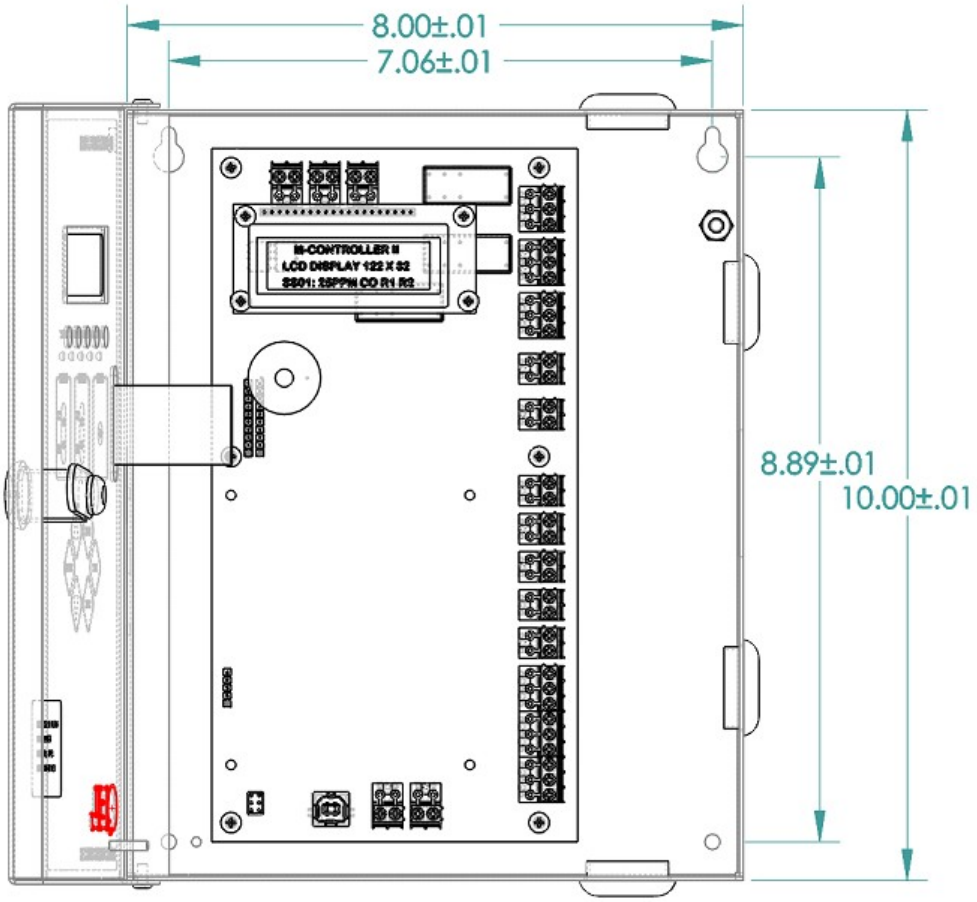
4.1 Type and Location

The M-Controller is designed and certified for installation in a fixed location. The location should be indoors and dry. Please observe the temperature and humidity specifications above for ambient conditions. Observe the possibility of leaks or possible water damage from cleaning done in the area.

Four mounting screw locations are provided on the base of the enclosure. The unit should be mounted to a wall or other fixture that remains in a fixed location.

The mounting height and location should provide easy access to the wiring terminals and front-panel. Backlighting is provided for the display in case of low lighting conditions.

It is recommended that controllers be installed 5 feet (1.5 m) above the floor, at approximate eye level. Securely mount the M-Controller using the appropriate screws.



4.2 Cabling

Approved cable conduit and conduit connectors should be used to ensure a safe and reliable installation. Check the local wiring code for more information. Make sure all conduit connectors are screwed in tight and that they are not coming in contact with any bare conductor.

Strain relief should be installed to the enclosure to prevent any mechanical stress from being transmitted to terminals and internal connections.

We recommend using BELDEN 9841 for communications. This wire has 120 ohms input impendence, which will eliminate RS-485 communication problems.

GES warrantees and support only covers installation with proper cable. If in doubt please contact GES support personnel.

4.3 Connectors

The terminal block TB1 to TB18 accept 12 AWG to 24 AWG wire, Use 16 AWG or 18 AWG wire for Power Supply in long wiring runs, which can be up to 1km (1,000 meters) long.

Make sure to observe wiring to the correct terminal blocks. Removable terminal blocks are provided. Make sure there is no confusion about which terminal block to wire to.

Note: **Incorrect wiring to any of the terminals of the M-Controller could cause permanent damage to the unit, which is not covered by the warranty. Incorrect wiring could also cause fire, electric shock, or bodily injury. Please observe the polarity on all connections.**

Warning: **Disconnect the mains supply and switch off the M-Controller when changing any of the wiring to the unit. Be especially cautious when wiring high voltage to the relays. Do not touch sensitive components on the circuit card to prevent static discharge damage to the unit.**

4.4 Power Requirements

The M-Controller power supply voltage requirements are nominally 24VAC or 24VDC

NOTE: M-Controller II has full-wave rectifier and half-wave rectifier circuit on board for flexibility. You will damage devices if you mix half wave and full wave rectifiers on the same AC source. Use extreme caution when sharing a common AC source. Sharing a common DC source is less problematic.

General Guideline:

- Old M-Controller uses full-wave rectifier only, if the M-Controller II is supposed to replace the old M-Controller, use TB7 for input power
- Q5 and Q8 both have full-wave and half-wave rectifier
- Old M-Relay, old M-Annunciator and QRP have a full-wave rectifier only
- M-Relay SMT version and M-Annunciator SMT version have full-wave and half-wave rectifier
- It is okay to connect multiple devices to the same AC transformer and share signal commons if
    - Every device uses a same style rectifier
    - And the same AC lead on every device is used for common
- If the power supply is 24VAC and half-wave rectifier circuit is selected, no matter it is GROUNDED (one side of AC is connected to ground), or FLOATING (neither side of AC is connected to ground), the polarization is important, make sure the Neutral or the same AC lead is connected to the GND of TB8. Make sure the same AC lead is connected to ground in all devices that share the AC source. Treat AC like DC for purposes of watching polarity in this case.
    - For Q5, the TB5 of Q5 can only be connected to the same AC source
    - For Q8, the TB6 of Q8 can only be connected to the same AC source
    - For other devices, only the device with half-wave rectifier can be connected to the same AC source. If it does not have, or any doubt exists, provide a dedicated isolated transformer to the device
- If the power supply is 24VDC, all the devices can be powered by the same DC source.
- Whenever you have different devices from different manufacturers, be careful to separate those devices that utilize a Full-wave rectifier from those using a Half-wave rectifier. When any doubt exists, provide a separate transformer. The small expense of an additional transformer or two will more than make up for all of the time and money spent on troubleshooting.
- Please refer to M-Controller Installation Drawing for power & RS-485 Connection
- It is necessary to bear in mind the actual installation when sizing the transformer. The installation requirements can run theoretically from only 15 VA to over 200 VA.
- It is always best to allow some safety margin in designing power supplies, and 25% to 50% allowance for startup surges and future requirements is recommended.
- M-Controller Common/Power Supply Negative is not connected to Chassis Safety Ground. AI Common is connected to M-Controller Common. Therefore, the power supplies for remote devices should be powered carefully to prevent ground loops. Remote Relay Module Negative is not connected to Chassis Safety Ground.
- All metal chassis are supplied with a safety ground to the case.

We supply one standard transformer

M-Transformer	120 to 24 VAC 200 VA

4.5 RS-485 Installation

The RS-485 (EIA-485) standard specifies the electrical characteristics for a digital communication link allowing communication between multiple devices on a single link. The RS-485 uses two wires, A+ and B-, and works on the voltage difference between them. If the voltage difference is positive, then that is a "1" if negative then that is a "0".

Connections: Wire terminals A+ to A+ to A+ etc., and B- to B- to B- etc.

End-Of-Line Termination Resistance: The terminator on each end of the RS485 loop is designed to match the electrical impedance characteristic of the twisted pair loop, and will prevent signal echoes from corrupting the data on the line. The terminator should be enabled on BOTH ends of the RS485 loop. Short and medium length modbus/485 loops can operate without the terminating resistor. Longer runs may require the terminating resistors. But adding a terminator dramatically increases power consumption. All GES equipment supplies the end-of-line resistor on the circuit card. It is enabled or disabled with a shunt jumper. (See relevant Installation Drawings for information).

M-Controller supplies this resistor on the main board, and it is chosen using a jumper at J3, J4, J5, J6 and J7.

JX 1-2: Terminator Disabled /OFF (Default)

JX 2-3: Terminator Enabled /ON

Factory default setting is disabled terminator.

Distances: The RS-485 standard allows up to 1300 meters (4000 feet) of line length. It is best to avoid lines of this length if at all possible.

Stubs: Short lengths of cable from the main cable over to a device are called Stubs. When the Baud rate (communication bit rate) is low – e.g. 2400 baud, then it is often possible to use short lengths of a few inches without seriously impairing the signal integrity, especially when overall distances are relatively short; however, this is taking a chance on garbling your signals and is not recommended.

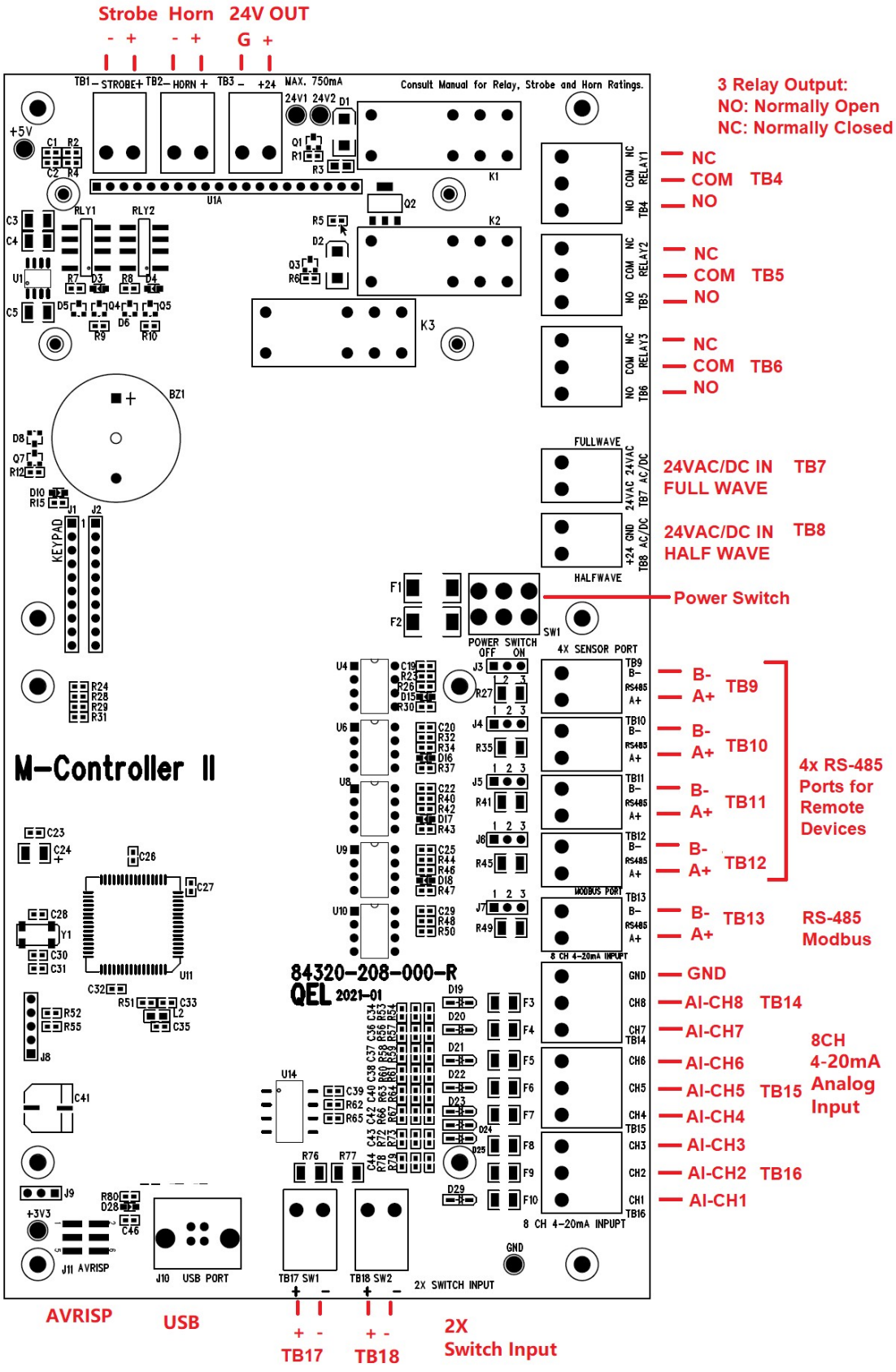
Cable Shields: Cable shields are aluminum and so only 'proof' against electrical fields, not against magnetic fields. The twist in the pair is to reduce the effects of magnetic fields. Take care not to run cable close to magnetic sources. Iron conduit is a good shield for both electrical and magnetic fields.

Shield Grounding: There are certain things to keep in mind for the shield.

- The shield must be grounded otherwise it can make the situation worse.
- Ground the shield at only one end to prevent ground loops.
- If you cut the cable then either ground each section of the shield at that point or connect the shields together to ground back at an origin point.

Devices and Ports: The RS-485 standard allows up to 32 devices on each communication line. The M-Controller supports up to 256 GES devices on each RS-485 port. The M-Controller does not need to be at the end of the line. The M-Controller has four RS-485 ports for remote devices (digital sensors and I/O modules). The ports are logically parallel so that it does not matter which port a sensor is connected to. This allows flexibility of wiring to suit wiring for zones, and reduction of length of lines. Minimizing the installation total wiring distances increases the reliability of the system.

RS-485 Driver Replacement: RS-485 lines in heavy industrial environments are sometimes subjected to magnetic disturbances causing sufficient inducted power surges to damage the driver integrated circuit (IC). This IC U6, U7, U8, U9 and U10 have sockets on the circuit card for ease of replacement in the field.


Strobe Horn 24V OUT
- + - + G +
TB1 – STROBE+ TB2 – HORN + TB3 – +24 MAX. 750mA
Consult Manual for Relay, Strobe and Horn Ratings.
3 Relay Output:
NO: Normally Open
NC: Normally Closed
NC
COM TB4
NO
NC
COM TB5
NO
NC
COM TB6
NO
FULLWAVE
24VAC/DC IN TB7
FULL WAVE
24VAC/DC IN TB8
HALF WAVE
HALFWAVE
Power Switch
POWER SWITCH OFF ON
4X SENSOR PORT
B-
A+ TB9
B-
A+ TB10
B-
A+ TB11
B-
A+ TB12
4x RS-485 Ports for Remote Devices
MODBUS PORT
B-
A+ TB13
RS-485 Modbus
8 CH 4-20mA INPUT
GND
AI-CH8 TB14
AI-CH7
AI-CH6
AI-CH5 TB15
AI-CH4
AI-CH3
AI-CH2 TB16
AI-CH1
8CH 4-20mA Analog Input
M-Controller II
84320-208-000-R
QEL 2021-01
KEYPAD
BZ1
2X SWITCH INPUT
TB17 SW1
TB18 SW2
J10 USB PORT
J11 AVRISP
AVRISP
USB
+ - TB17
+ - TB18
2X Switch Input

5 M-Controller supports Devices

5.1 Input Devices

- 32x Digital Sensors: Q5, Q6, Q8, M5, QTS-8000, QIRF, M-AI …
- 8 channels Analog Sensors: QTS-6000, QTS1710 …
- 2 channels Switch Input: Q-Switch or any dry contact

5.2 Output Devices

- M-Relay: Each M-Relay takes 8 relay addresses.
  Relay numbering from the standpoint of the M-Controller is numbered consecutively with numbers 1, 2 and 3 being the M-Controller internal relays and numbers 4 through 99 the relays in the remote modules.

  For example, the 8 relays in the M-Relay #0 will be named Relay4 to Relay11 in M-Controller. Details see M-Relay Manual (84350-104-000)

  M-Controller also names M-Relay with its address and channel, like "MR-XX-YY", where XX is the M-Relay address and YY is Channel 1 to 8. MR-00-01 indicates Relay 1 in M-Relay module #0.

- QRP: Each QRP takes 8 relay addresses too.
  QRP is a remote display panel for M-Controller to display relay status and gas concentration. It contains 4x removable relays and 3x 24VDC transistor output for local alarms, fans, buzzer, strobe and horn. So, it only uses 7 relays addresses for the 4 relays and 3 transistor outputs, the 8th relay address is empty.

  For example, the Relay1 to Relay4 in the QRP #1 will be named Relay12 to Relay15 in M-Controller, buzzer, strobe and horn in the QRP #1 will be named Relay 16 to Relay 18, Relay 19 is empty. Details see QRP Manual (86050-001-000)

  M-Controller also names QRP with its address and channel, like "QRP-XX-YY", where XX is the QRP address and YY is the Relay 1 to 4 and its onboard buzzer, strobe, and horn.

- M-Annunciator: Each M-Annunciator takes 8 relays address too
  M-Annunciator provides an audible and visual indication of the status of the system. It contains 3x LEDs to indicate a certain state of the controller. It only use 3 relays addresses for the 3 Warning, Alarm and Failure LEDs, the 4-8 relay address is empty.

  For example, the 3xLEDs in the M-Annunciator #2 will be named Relay20 to Relay22 in M-Controller, Relay 23-27 are empty. Details see M-Annunciator Manual (84750-101-000)

M-Controller also names M-Annunciator with its address and channel, like "MA-XX-YY", where XX is the M-Annunciator address and YY is the Waring LED, Alarm LED and Fail LED indicators.

- M-Logger is no longer supported by the M-Controller II
- RDF52: M-Controller supports up to 16 RDF52 units.
  The RDF52 can be assigned to one of M-Controller's eight zones, all units in the same zone will perform identical functions. The RDF52 will make the M-Controller system easily compliance with ASHRAE 15 and CSA-B52 standards.

6 M-Controller Functions

After the controller powers up, it will show no enabled inputs and outputs on the LCD display, as no input or output is enabled in the factory defaults settings. You need to enter MENU to config the M-Controller. The menu is password protected. Default password is 4321.

6.1 Miscellaneous

Setting	Description
Password:	Default password is 4321
Baud Rate:	Modbus RTU RS-485 Port: • default baud rate is 19.2kbps, no parity Sensor RS-485 Port: • default baud rate is 4800bps
LCD Backlight:	The LCD backlight can be set to • Always Off • Always On • AUTO In AUTO mode, the backlight will turn On for 10 seconds after any key has been pressed **Default setting is AUTO mode**
4mA and 20mA AI Calibration: **AO Calibrations:**	These values are established during factory calibration and should not require recalibration in the field. Do not attempt to modify these settings in the field Changing these values will change the analog output signal scale Warning: This procedure is part of the factory setup. In most circumstances it will not be necessary to perform this procedure in the field. These functions require the use of precision reference instrumentation

6.2 Relay Configurations

Relay1-3 and M-Relay configurations may be styled in two basic ways: Voting and Averaging. Each method allows certain advantages and limitations. Common functions apply to both styles.

Common Functions	Description
On Delay:	**Delay on Actuation ('Delay on Make'). For each relay, a separate time delay may be set up to 60 minutes before an alarm condition will cause the relay to actuate** **Default is 00 minutes**
Off Delay:	Delay on De-Actuation ('Delay on Break'). For each relay, a separate time delay may be set up to 60 minutes before a return to a non-alarming signal condition will cause the relay to de-actuate **Default is 00 minutes**
Normally De-energized:	Each relay may be individually set to be normally energized or normally de-energized Default is normally de-energized
Latching:	Each relay may be set to latch in actuate status until acknowledged by a front-panel action **Default is Non-Latching**
Style:	Normal Relay Style: • Work as normal relay Buzzer Style Relay: • When the relay is used to control a buzzer or horn. Working as a buzzer style will make the relay have the same function as the buzzer. It will be switched off when performing the Hush function **Default is Normal Relay Style**
Enabled	Each relay may be individually set to be enabled or disabled. If it's disabled, the relay will always de-actuate no matter what the current gas concentration **Default is Disabled**
Fault Actuation	When relay is set with Fault Actuation, the relay will be actuated when its assigned sensors report any fault or offline **Default is Disabled**

- Voting Mode

Settings	Description
Voting Number:	For a given list of sensors assigned to a relay actuation list, this number indicates the minimum number of sensors which must pass or equal their alarm "On" concentration before the relay will actuate **Default is 1**
Assign Sensor:	Each relay may be assigned to any one or more of the enabled sensors or AI (Analog Inputs)
On Concentration Reading: **Off Concentration Reading:**	**If On Concentration is great than or equal to Off Concentration:** On Concentration: For each sensor or analog input assigned, set the concentration at or above which the voting number will increase 1 Off Concentration: For each sensor or analog input assigned, set the concentration at or below which the voting number will decrease 1
On Concentration Reading: **Off Concentration Reading:**	**If On Concentration is less than Off Concentration:** On Concentration: For each sensor or analog input assigned, set the concentration below which the voting number will increase 1 Off Concentration: For each sensor or analog input assigned, set the concentration above which the voting number will decrease 1

- Averaging Mode

When working in Averaging mode, the Voting mode is disabled, and the Voting Number is forbidden automatically. Input values to “Average On”, “Average Off”.

If Average On is great than or equal to Average Off:

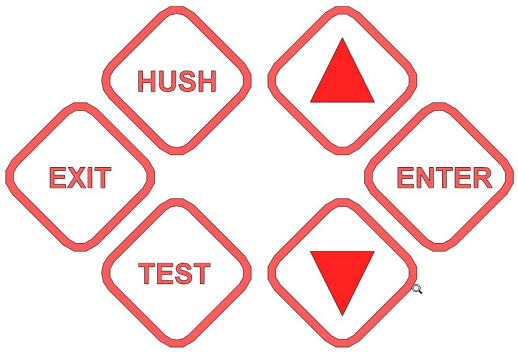
Settings	Description
Average On:	The gas concentration at or above which the average of all the sensors assigned to this relay will cause the relay to actuate
Average Off:	The gas concentration at or below which the average of all the sensors assigned to this relay will cause the relay to de-actuate

If Average On is less than Average Off:

Settings	Description
Average On:	The gas concentration at or below which the average of all the sensors assigned to this relay will cause the relay to actuate
Average Off:	The gas concentration at or above which the average of all the sensors assigned to this relay will cause the relay to de-actuate

6.3 Keypad and Menu

All database programming and configuration can be done through the front panel keypad, although this is practical only for short programs and program modifications. The following discussion and tables demonstrate the operation and menu pathways. In practice you will find that it is easier to use the keypad and menus than it is to read the reference descriptions. The menus provide prompting at each stage, and only a few rules need be memorized.



- Hold Mode:
  Press key [Up] or [Down] to scroll through the display items, at the same time the display goes to “Hold Mode” with display “*” at that row end. The Hold Mode will stop at that point for 3 minutes.

  In Hold Mode, press key [Enter], you can check the selected channel running status and its config settings in the controller.

  Press key [Exit] exits the hold mode to auto scroll mode.

- Key [Hush]
  Press key [Hush] to silence the alarmed Buzzer and Horn, and all alarmed buzzer-style relays.

- Key [Test]
  For system testing, press key [Test] to force relay1-3, and all M-Relays actuate.

Menu Mode:

Press key [Enter] during monitoring mode but not "Hold Mode", to enter to Menu Mode. Main Menu is password protected. Default password is 4321.

```
MENU
 > 1. ENTER MAIN MENU
    2. RESET LATCHED
    3. RESET PASSWORD
    4. CHECK DATABASE
    5. UNHUSH BUZZERS
    6. UNLATCH ALL RDF52
```

- Menu "Enter Main Menu"
  - Once the password is accepted, you will enter to main menu tree.

- Menu "Reset Latched"
  - To acknowledge a latched condition. All latched relays for which the alarm condition has been removed will reset. If the alarm condition (e.g., high gas concentration) is still present the relay(s) will not reset.

- Menu "Reset Password"
  - If you forgot the main menu password, you could reset the menu password to default password "4321" by entering a correct active code. For the active code, contact GES.

- Menu "Check Database"
  - You can always verify the input and output config database integrity. For example, if you accidently assigned a non-existed input (disabled input) to an output, it would show a warning here.

- Menu "Unhush Buzzers"
  - Remove Hush status from hushed outputs, the output will be alarmed again after On Delay minutes.

- Menu "Unlatch All RDF52"
  - To unlatch all FAN Switches in all of RDF52s.

6.4 Menu "System Setting"

The Menu system setup contains general settings for monitor operations, communications and 4-20mA calibrations.

Settings	Description
Backlight:	Can be set to "Always ON", "Always OFF", "AUTO" **Default setting is AUTO mode**
CAL AI 4mA:	For factory calibration. Do not attempt to modify these settings in the field
CAL AI 20mA:	For factory calibration. Do not attempt to modify these settings in the field
Modbus Address:	The slave device address in Modbus RTU protocol **Default is 3**
Modbus Baud Rate:	Baud rate for Modbus port **Default is 19200bps**
Modbus Parity:	Parity bit for Modbus port **Default is no parity**
Change Password:	The new password can be any combination of up to four digits **Default password is 4321**
Key Beeper:	Beeping or not when the keypad is pressed **Default is ON**
Strobe Out:	When the strobe is actuated, it can be set with either 100% duty cycle ON or 50% duty cycle ON, so the strobe can be flashed by the strobe relay ON and OFF at 50% duty cycle **Default is 100% duty ON**
M-Relay: **M-Annunciator:** **QRP:**	Show how many M-Relay, M-Annunciator and QPR installed in the system You can define each device address here

Show BO Name:	If the parameter is OFF: all relays output will be displayed and named with "R-XX", such as R04 to R99 to represent relay4 to relay99 If the parameter is ON: all relays output will be display with MR-XX-YY, or MA-XX-YY, or QRP-XX-YY. MR means M-Relay, MA means M-Annunciator XX is the device box address, YY is the channel number 1 up to 8 **Default is ON**
CAL AO-Board 4mA:	For factory calibration. Do not attempt to modify these settings in the field
CAL AO-Board 20mA:	For factory calibration. Do not attempt to modify these settings in the field
QC CAL AI 4-20mA:	For factory calibration. Do not attempt to modify these settings in the field
QC CAL AO-Board:	For factory calibration. Do not attempt to modify these settings in the field

6.5 Menu "Sensor Setting"

For digital sensor 0 to sensor 31 configuration

To assign a sensor or analog input to any of the output devices (relays, buzzers, and AO Board) the sensor must already have been enabled in the sensor settings.

Only the enabled sensors will be polled and monitored by the controller. The sensor's gas type and measurement unit will be read out of each enabled sensor.

Settings	Description
Enable:	The M-Controller must be told that a sensor is attached to the control system

6.6 Menu "AI Setting"

For Analog Input Channel 1 to Channel 8 configuration

Settings	Description
Enable:	The Controller must be told which channels are active
Gas Type:	Set the gas type for the display only.
Gas Unit:	Set the units of measurement for the display only
Reading at 4mA: **Reading at 20mA:**	Assign the two readings at 4.0 milliamps and 20.0 milliamps input signal. You may even assign a gas concentration to 4.0mA, which is higher than the concentration assigned to 20.0mA. The M-Controller will draw a straight line between.

6.7 Menu "BI Setting"

For Switch / Binary Input Channel 1 and Channel 2 configuration

Settings	Description
Enable:	The Controller must be told which channels are active
Work Style:	_Acuate Outputs: • When the BI is ON, the assigned output will be overridden to ON state. The Switch can be used to manually actuate assigned outputs _Hush Buzzer and Relay: • When the BI is ON, all alarmed buzzers and buzzer style relays will be Hushed _Clear Latched Relay: • When the BI is ON, all latched relays will be clear and reset. The switch needs to press again to switch OFF manually when it's shown "Expired"
Assigned Output:	Available outputs: • Relay1- Relay3, Buzzer1 – Buzzer 3, Strobe • Enabled M-Relay, M-Annunciator and QRP • Enabled AO-Board (AO-1 to AO-8)

6.8 Menu "Relay 1 - 3"

For on-board Relay1 to Relay3 configuration

Settings	Description
Enable:	The Controller must be told which relays are active
Work style:	Normal Relay Style or Buzzer Relay Style
Normally Energized	Normally De-Energized or Normally Energized
Latched	See relay configuration in 6.2
Voting Mode:	See relay configuration in 6.2
Averaging Mode:	See relay configuration in 6.2
On Delay (Minutes):	See relay configuration in 6.2
Off Delay (Minutes):	See relay configuration in 6.2
Fault Acturation:	See relay configuration in 6.2

6.9 Menu "M-Relay"

Select enabled M-Relay, set address and each channel relay configuration

Settings	Description
Device from Address 0 to Address 11:	Available devices: • M-Relay • M-Annunciator • QRP • Not Install
Select Channel	Select the channel of enabled device
Relay Setting	Set the channel relay configuration See relay configuration in 6.2

6.10 Menu "Zone Setting"

M-Controller supports up to 8 Zones. The RDF52 can be assigned to one of the 8 zones, all RDF52s in the same zone will perform identical functions.

Zone Configuration:

Settings	Description
High Alarm On Level:	For each sensor or analog input assigned, set the concentration at or above which the high alarm will be ON. • Default is 500ppm.
High Alarm Off Level:	For each sensor or analog input assigned, set the concentration at or below which the high alarm will be OFF. • Default is 450ppm.
Low Alarm On Level:	For each sensor or analog input assigned, set the concentration at or above which the low alarm will be ON • Default is 300ppm.
Low Alarm Off Level:	For each sensor or analog input assigned, set the concentration at or below which the low alarm will be OFF. • Default is 250ppm.
Low Alarm Trigger:	When low alarm is ON, which relay will be actuated. • Default is relay1.
High Alarm Trigger:	When high alarm is ON, which relay will be actuated. • Default is relay1 and relay3.
FAN Switch Trigger:	When FAN Switch in RDF52 is ON, which relay will be actuated. • Default is relay1.
Hush DeEnergize:	When Hush button is pressed in RDF52, which relay will be deenergized. • Default is no relay
Treat Sensor fault:	• Faults do nothing. (No relay triggered) • As Low Alarm When the assigned sensors in the zone report fault, the fault will trigger Low alarm, low alarm will trigger assigned relays. Default is "As Low Alarm"

6.11 Menu "RDF52 Setting"

RDF52 Configuration:

Settings	Description
Zone:	Assign the RDF52 to a zone.
FAN Switch Latch Style:	• Latch Style Latched mode is used to the RDF52 which is located outside the mechanical room, so it shall be capable of starting but not stopping the ventilation. • Non-Latch Style Non-latch mode is used to the RDF52 which is located inside the mechanical room, so it shall be capable of starting and stopping the ventilation. When it's stopping the ventilation, all RDF52 Fan switches are switched OFF.

6.12 Menu "AO Setting"

For option daughter board AO-Board CH1 to CH8 configuration
Details see AO Board Operation Manual (84350-212-000)

Settings	Description
Select Channel:	AO-1 to AO-8
Enable:	The Controller must be told which channels are active
Work Style:	_Base Concentration _Base AI mA Value
Work Mode:	AO output calculation work mode: _Averaging Mode _Peak Mode
Reading at 4mA: **Reading at 20mA:**	Assign a value (which can be a concentration or mA value depending on the work style of the channel) for both the 4.0mA signal, and the 20mA signal. You may assign a larger value for 4.0 milliamps than for 20 milliamps; the M-Controller will still stretch a straight-line signal between the two points.

6.13 Menu "Buzzer / Strobe"

Settings	Description
Enable:	**The Controller must be told which channels are active**
Voting Mode:	**See relay configuration in 6.2**
Averaging Mode:	**See relay configuration in 6.2**
On Delay (Minutes):	**See relay configuration in 6.2**
Off Delay (Minutes):	**See relay configuration in 6.2**
Fault Acturation:	**See relay configuration in 6.2**

6.14 Menu "Assign Output"

Each output can be assigned their own inputs with the alarm settings associated with the input as applied to the output only.

Settings	Description
Select Channel:	Available outputs: • Relay1 to Relay3 • M-Relay 0 to 11 • AO CH1 to CH8 • Buzzer and Strobe • Zone 1 to Zone 8
Assigned Input:	Available inputs: • Digital Sensor 0 to Sensor 31 • AI CH1 to CH8
On Concentration:	When the sensor is assigned to a Relay or Buzzer/Strobe • When the relay is working with voting mode, the sensor's On Concentration is needed. See relay configuration in 6.2.1

	• When the relay is working with averaging mode, the sensor's On Concentration is not needed.
Off Concentration:	See above, only for relay/buzzer/strobe voting mode
Reading at 4mA:	When a sensor is assigned to an Analog Output • When the AO is calculated with "Base AI mA Value", the digital sensor's concentration needs to convert to mA value, this is the concentration at 4mA output • When the AO is calculated with "Base Concentration", the value is not needed.
Reading at 20mA:	See above, only for AO with "Base AI mA Value"

6.15 Menu "I/O Setting"

For system installation testing, it is necessary to force relay, buzzer, strobe, and AO actions as well as checking AI and BI inputs status.

The Relay Testing forces an actuate vs. de-actuate action, not an energized vs. non-energized action. Therefore, the user must be aware of those relays which have been defined as normally energized or normally de-energized.

Settings	Description
BI CH1-2 Test:	Show the BI1 and BI2 ON/OFF status
AI CH1-8 Test:	Show the mA value from AI1 to AI8
Sensor & Modbus:	For Factory Testing only Set Sensor port and Modbus port to be 19.2K Modbus RTU protocol with no parity. For Factory RS-485 Tester to quick test the RS-485 ports
Relay 1-3 Test:	Manually actuate / de-actuate Relay1 to Relay3
Buzzer & Strobe:	Manually actuate / de-actuate Buzzer1 to Buzzer3 and Strobe
M-Relay Box 0-11:	Manually actuate / de-actuate Relay1 to Relay8 in the M-Relay
AO CH1-8 Test	Manually switch the AO output between 4mA and 20mA

6.16 Menu "Calibration Mode"

When Calibration mode is enabled, the relay, strobe, etc., status will freeze in whatever state they are already in.

6.17 Menu "BACnet"

To support BACnet BAC-Box, the setting of "BACnet" must be Enabled. When it's enabled, the Modbus protocol is disabled automatically.
BAC-Box supports DHCP and static IP both IP address assignments. Each device must have a unique IP address and unique BACnet ID# on a network. Your system administrator generally provides the IP address and corresponding subnet mask and gateway if static IP address is selected.

7 How to Create a Database

The base concept is to tell the M-Controller it has sensors and what they are. Then tell the M-Controller it has relays and how they will function. Finally tell the M-Controller how the sensors and relays work together.

Following these steps will help you to create your database quickly and easily:

1. Requirements Analysis.

Before you create your database, you should write out a requirements analysis.

A. How many remote sensors are there in your system? For each digital sensor, assign a unique address to each one

B. How many channels of 4-20mA analog input? List their channel numbers, gas type, unit of measure, and range of measure.

C. Do you need 4-20mA analog output? if yes, list the concentration or mA value of 4mA and the concentration or mA value of 20mA, and what kind of input signal it is? How many inputs signal?

D. Do you need a remote relay (M-Relay)? Remote display (M-Annunciator and QPR)? What kind of relay style? (Normally Energized? Latching? voting mode or average mode? time delay? How many minutes? List assigned sensors)

E. Setup for Buzzer, Horn and Strobe. (Voting mode or Average mode? Does it need time delay? How many minutes? List assigned sensors)

F. Do you need a Modbus RTU or BACnet /IP to report the controller running status to other DCS

G. Setup system settings, such as password and LCD Backlight mode.

2. Enter the database.

The database can be input using M-View which is a database setup software with a friendly Man Machine Interface running on a PC computer, it supports downloading and uploading the database to/from M-Controller. The database can also be input through the keypad on M-Controller.

A. Input data for all remote sensors.

B. Input all analog inputs data.

Note: You must have enabled each required sensor or analog input before you can assign it to a relay or analog output function.

C. Setup all relay styles.

D. Setup all analog outputs.

E. Setup buzzers and strobe

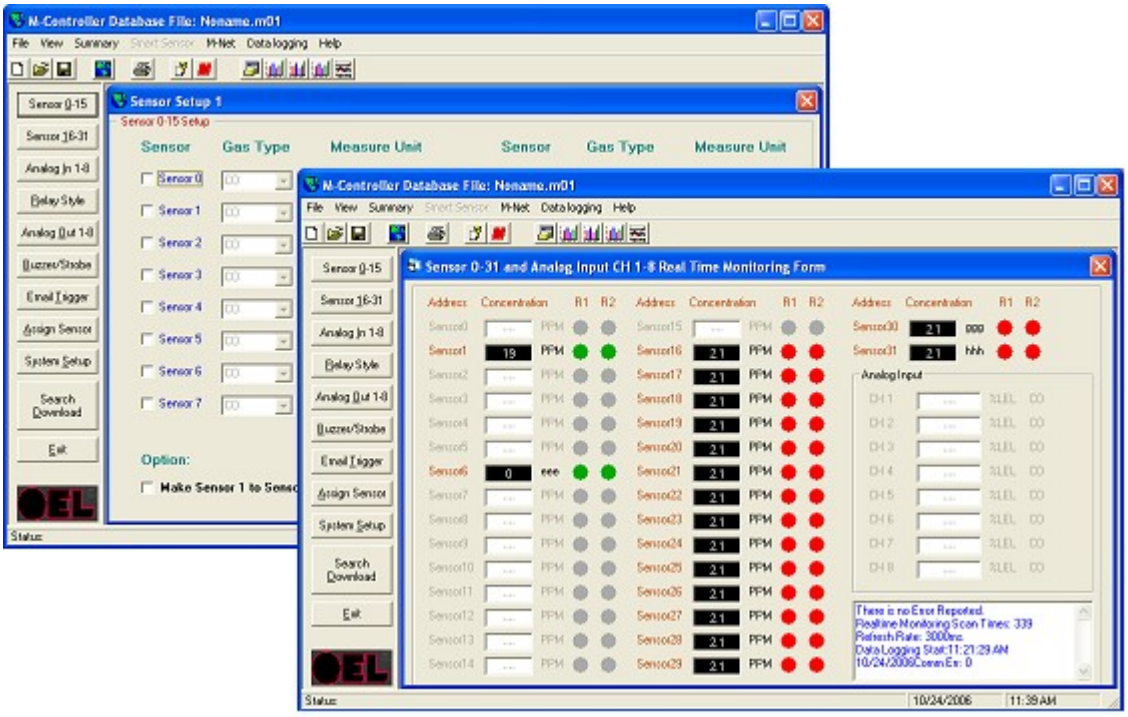
F. Setup system settings.

8 Computer Interface: Programming and Auditing

NOTE: WHEN PROGRAMMING THE M-CONTROLLER WITH A LAPTOP ENSURE THAT THE LAPTOP IS NOT CONNECTED TO ANY POWER SOURCE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT WITH DAMAGES TO THE CONTROLLER AND OTHER DEVICES CONNECTED TO IT.

The M-Controller can be fully configured and programmed from the keypad; however, for even moderately complex networks this task becomes tedious. Therefore, we have supplied an interface and computer program (**M-View**) to allow all database programming to be setup on a computer (laptop) and downloaded to the M-Controller.

USB A male to USB B male cable is included in the M-Controller shipping package.



NOTE:
WHEN PROGRAMMING THE M-CONTROLLER WITH A LAPTOP THROUGH USB PORT ENSURE THAT THE LAPTOP IS NOT CONNECTED TO ANY POWER SOURCE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT WITH DAMAGES TO THE CONTROLLER AND OTHER DEVICES CONNECTED TO IT.

8.1 M-View Installation

The M-View software has been designed as an easy-to-use configuration software package, greatly reducing the lengthy task of entering individual keystrokes through the keypad to quick configuration with the mouse. M-View allows for both programming and audit control, as you may download, upload and save programs to disk. Professional Version M-View also can Real Time Monitoring the current readings and statuses of M-Controller, Data logging these readings and statuses and Historical Data Review.

Standard Version M-View is limited to the three functions but have 5 minutes Real Time Monitoring function. The Standard Version M-View is free for all M-Controller users.

Minimum system requirements:

Operating System:	Windows XP or better
Ram:	16 Megabyte of RAM
Hard drive:	50 Megabytes free
Speed:	Any
Mouse:	Preferred (can navigate by 'tab')
USB Port:	USB A

To install M-View, insert the CD or USB Flash drive into the computer and run Setup.exe. Follow the instructions on the screen.

If your computer installed previous version M-View, the setup program will remove it first, then run Setup.exe again to install the latest version M-View.

NOTE:
WHEN PROGRAMMING THE M-CONTROLLER WITH A LAPTOP THROUGH USB PORT ENSURE THAT THE LAPTOP IS NOT CONNECTED TO ANY POWER SOURCE. FAILURE TO FOLLOW THESE INSTRUCTIONS COULD RESULT WITH DAMAGES TO THE CONTROLLER AND OTHER DEVICES CONNECTED TO IT.

9 MODBUS Protocol Supported By M-Controller

9.1 Serial Transmission Mode

- Modbus RTU Slave Mode
- Baud rate: 19.2K, 28.8K, 38.4K, and 57.6K, selectable from Modbus Baud Rate in System Setting Menu.
- Byte parity: no parity (default), Even, Odd
- Data format: One start bit, 8 data bit, no parity bit, one stop bit, LSB first.
- Frame Check: CRC check.

9.2 Function Code Supported by M-Controller

- **#03 Read Holding Registers**

Function in M-Controller: Read inputs and outputs statuses and readings, such as

- Relay Statuses
- Analog output current (mA x 10)
- Analog inputs readings
- Digital Sensor readings and statuses
- Buzzers, Strobe and Triggers statuses

Attribute: Read Only.
Broadcast is not supported.

Query:

Slave Address:	xx	(Default 03, check Slave address in M-Controller)
Function code:	03	
Starting addr. Hi:	000	
Starting addr. Lo:	xxx	(00 to 122)
No. of points Hi:	000	
No. of points Lo:	xxx	(01 to 123)
CRC check:	xxxxH	

Example: to read all holding registers in M-Controller (Slave Address: 214)
Query: [214] [003] [000] [000] [000] [123] [023] [206] in unsigned decimal.

Holding Register Address Table

Modbus	Name	Description
40001	Relay1 and Relay 2 Statuses	Relay1 status in High 8 bits, Relay 2 status in Low 8 bits Status Byte Definition: 0: Normal 1: Sensor Alarm 2: Communication Error 3: Offline 4: Sensor Gas type Error 5: Relay/Buzzer/Strobe/Trigger in On Delay process 6: Relay/Buzzer/Strobe in Off Delay process 7: Relay in Latched Status 8: Relay/Buzzer/Strobe/Trigger On 9: Relay/Buzzer/Strobe/Trigger Off 10: Relay/Buzzer/Strobe/Trigger in On Delay process (same as 5) 11: Relay/Buzzer/Strobe in Off Delay process (same as 6) 12: No Sensor is assigned to Relay/Buzzer/Strobe/Trigger 13: Buzzer or Buzzer Style Relay is hushed 14: Sensor Fault 15 or 22: Override ON 17 or 23: Override OFF 128: Disabled
40002	Relay3 and Relay4 Statuses	Relay3 status in High 8 bits, Relay 4 status in Low 8 bits Status Byte Definition see 40001
40003 to 40049	Relay5 to Relay98 Statuses	Relay5, 7, 9 … status in High 8 bits, Relay6, 8, 10 … status in Low 8 bits Status Byte Definition see 40001
40050	Relay99 Status	Relay99 status in High 8 bits, Low 8 bits is no use Status Byte Definition see 40001

40051	Analog Output CH1 and CH2 Statuses & mA reading	A-Out CH1 in High 8 bits, A-Out CH2 in Low 8 bits
		Byte Definition:
		0: Disabled Channel
		1 – 255: Analog Output Current Value (mA) X 10
		Example:
		If (Byte) = 200, the Analog Output value is 20.0 mA.
		If (Byte) = 41, the Analog Output value is 4.1 mA.
		If (Byte) = 0, the Analog Output is disabled.

40052 to 40054	Analog Output CH3 to CH8 Statuses & mA reading	A-Out CH3, 5, 7 in High 8 bits, A-Out CH4, 6, 8 in Low 8 bits Byte Definition see 40051
40055	Buzzer1 and Buzzer2 Statuses	Buzzer1 status in High 8 bits, Buzzer2 status in Low 8 bits Status Byte Definition see 40001
40056	Buzzer3 and Strobe Statuses	Buzzer3 status in High 8 bits, Strobe status in Low 8 bits Status Byte Definition see 40001

40057	Trigger1 and Trigger2 Statuses	Trigger1 status in High 8 bits, Trigger2 status in Low 8 bits Status Byte Definition see 40001
40058	Trigger3 Status	Trigger3 status in High 8 bits, Low 8 bits is no use Status Byte Definition see 40001
40059	Digital Sensor 0-7 Relay Statuses	Usually, Each Digital Sensor has two Relays onboard: • Relay High (H) and Relay Low (L) bit(1): ON, bit(0): OFF b15…b8= Sensor 3H,3L,2H,2L,1H,1L,0H,0L b7…b0= Sensor 7H,7L,6H,6L,5H,5L,4H,4L
40060	Digital Sensor 8-15 Relay Statuses	B15…b8= Sensor 11H,11L,10H,10L,9H,9L,8H,8L b7…b0= Sensor 15H,15L,14H,14L,13H,13L,12H,12L
40061	Digital Sensor 16-23 Relay Statuses	B15…b8= Sensor 19H,19L,18H,18L,17H,17L,16H,16L) b7…b0= Sensor 23H,23L,22H,22L,21H,21L,20H,20L
40062	Digital Sensor 24-31 Relay Statuses	B15…b8= Sensor 27H,27L,26H,26L,25H,25L,24H,24L b7…b0= Sensor 31H,31L,30H,30L,29H,29L,28H,28L
40063	Digital Sensor 0 and Sensor 1 Statuses	Sensor 0 in High 8 bits, Sensor 1 in Low 8 bits Byte Status Definition: b7, b3 … b0 is Sensor Status, Status Definition see 40001, b6, b5, b4 is Decimal Position for its Reading in 40083 example: b6, b5, b4 = 000, The actual reading is Reading in 40083 b6, b5, b4 = 001, The actual reading is Reading / 10 b6, b5, b4 = 010, The actual reading is Reading / 100 b6, b5, b4 = 011, The actual reading is Reading / 1000
40064 to 40078	Digital Sensor 2 – 31 Statuses	Sensor 2, 4, 6 … in High 8 bits, Sensor 3, 5, 7 … in Low 8 bits Byte Status Definition see 40063
40079	Analog Input CH1 and CH2 Statues	A-In CH1 in High 8 bits, A-In CH2 in Low 8 bits Byte Status Definition see 40063
40080 to 40082	Analog Input CH3 - 8 Statuses	A-In CH3, 5, 7 in High 8 bits, A-In CH4, 6, 8 in Low 8 bits Byte Status Definition see 40063
40083	Digital Sensor 0 Gas Reading without Decimal	The Gas Reading is 16 bits signed integer. The Actual Reading of the sensor should be divided by its Decimal Position, see 40063
40084 to 40114	Digital Sensor1-31 Gas Reading without Decimal	Same as Definition in 40083
40115	Analog Input CH1 Reading without Decimal	The Reading is 16 bits signed integer. The Actual Reading of the Analog Input should be divided by its Decimal Position in 40079
40116 to 40122	Analog Input CH2-8 Reading without Decimal	Same as Definition in 40115

40123	M-Controller Self Diagnostics Report	Fault Flag Reg. b0 = 1, no analog output daughter board plug in b0 = 0, normal b1 = 1, polling remote relay fault b1 = 0, normal b2 = 1, polling remote sensors fault b2 = 0, normal b3 = 1, remote sensor has fault b3 = 0, normal b4 = 1, no sensor assigned to an analog output b4 = 0, normal b5 = 1, no sensor assigned to a buzzer or a trigger b5 = 0, normal b6 = 1, no sensor assigned to the strobe b6 = 0, normal b7 = 1, no sensor assigned to relays b7 = 0, normal b8 = 1, Calibration Disable is ON b8 = 0, Calibration Disable is OFF b9 … b15 reserved

- #17(11H) Report Slave ID

Function in M-Controller:

Return a description of the type of controller present at the slave address with its specification.

Broadcast is not supported.

Query:

Slave Addr.:	xxH
Function code:	11H
CRC check:	xxxxH

Response:

Slave addr.:	xxH	
Function code:	11H	
Byte count:	86H	
Slave ID:	82H	
Run Indicator status:	FFH	(always ON)
Software Version:	(2 Bytes)	major version first
Controller Serial Number	(2 Bytes)	high byte first
Special Gas Type [8][3]	(24 Bytes)	8 Special Gas Type
Special Unit [8][3]	(24 Bytes)	8 Special Unit
Gas Type	(40 Bytes)	Sensor 0 first, plus 8CH A_In
Unit of Measure	(40 bytes)	Sensor 0 first, plus 8CH A_In
CRC check:	xxxxH	

Note:

1). Slave ID = 80H for M-Controller
Slave ID = 82H for M-Controller II
Slave ID = 42H for Q4-Controller II

2). Each Special Gas Type or Special Unit is composed of 3 characters.

3). Gas type and Units Definition:

Value	Gas Type	Units
00H	O2	%Vol
01H	CO	PPM
02H	CO2	%LEL
03H	H2S	UNITS
04H	SO2	Special Unit 1
05H	NO	Special Unit 2
06H	NO2	Special Unit 3
07H	Hydrogen	Special Unit 4
08H	HCN	Special Unit 5
09H	HCL	Special Unit 6
0AH	NH3	Special Unit 7
0BH	MMH	Special Unit 8
0CH	O3	
0DH	C2H4O	
0EH	Cl2	
0FH	ClO2	
10H	CH4	
11H	C3H8	
12H	H2	
13H	Others	
14H	Special Gas Type 1	
15H	Special Gas Type 2	
16H	Special Gas Type 3	
17H	Special Gas Type 4	
18H	Special Gas Type 5	

19H	Special Gas Type 6
20H	Special Gas Type 7
21H	Special Gas Type 8

10 Troubleshooting Hints

M-Controller has advanced features and functions. Before assuming that unexpected behavior is caused by a system defect or breakdown, the operator should use this manual to become thoroughly familiar with M-Controller operation. This troubleshooting guide is intended as an aid in identifying the cause of unexpected behavior and determining whether the behavior is due to normal operation or an internal or external problem.

Identify the symptom or unexpected behavior you are observing from the **SYMPTOMS** listed in the table. A **PROBABLE CAUSE** is provided, and a suggested **SOLUTION** is proposed including references to manual sections that provide information that may be of assistance.

SYMPTOMS	PROBABLE CAUSE	SUGGESTED SOLUTION
LCD Display does not come on	• No power supply • LCD has problem • Program has crashed	• Check power / ground connections • Change LCD • Reprogram
M-View reports “M-Controller is offline”	• M-Controller is not turned on • M-Controller is working in Menu Mode. • USB driver is recognized	• Turn on M-Controller • Exit Menu mode to Monitoring mode • Check M-Controller is connected properly. Remove USB cable and plug it back again
M-Controller reports “Vote no Sensor!” or “AV no Sensor!”	• No sensor was assigned to the output (relay or analog output)	• Assign sensor to the output
M-Controller reports “Sensor Offline” or “Relay Offline”	• Comm setting is wrong • Connection is wrong • Remote Device is in Fault • End-of-line matching resistors are not properly set.	• Check if the remote sensor baud rate is 4800 bps • Check connection between M-Controller and Digital Sensor and M-Relay. Make sure all have power on and no shorts or opens in wiring. Be certain that polarity for RS-485 connections is correct. A-A and B-B • Examine remote devices • Review end-of-line resistor settings
RS-485 Sensor Port or Modbus Port RX/TX LED constantly ON	• RS-485 bus connection has a problem • RS-485 driver chip is damaged	• Disconnect the cable to isolate the problem • Replace RS-485 driver chip

11 WARRANTY STATEMENT

The information contained in this manual is based upon data considered accurate; however, no warranty is expressed or implied regarding the accuracy of this data. All GES equipment is warranted against defects in material and workmanship for a period of two years from date of shipment with the following exceptions:

Electrochemical Sensors (Toxic)	Six Months
Catalytic Sensors (Combustible)	One Year

During the warranty period we will repair or replace, at our discretion, any components or complete units that prove, in our opinion, to be defective. We are not liable for consequential or incidental damage to auxiliary interfaced equipment.

A returned material authorization number should be obtained from the factory prior to returning any goods. All return shipments must be shipped freight prepaid and a copy of the maintenance records should accompany the unit concerned.

Warranty should be considered F.O.B. the factory. Labour and travel time are chargeable for any field site visits required for warranty work.

LIMITED LIABILITY

All GES systems shall be installed by a qualified technician/electrician and maintained in strict accordance with data provided for individual systems in the form of installation/maintenance manuals. GES assumes no responsibility for improper installation, maintenance, etc., and stresses the importance of reading all manuals. GES shall not be responsible for any liability arising from auxiliary interfaced equipment nor any damage resulting from the installation or operation of this equipment.

GES's total liability is contained as above with no other liability expressed or implied, as the purchaser is entirely responsible for installation and maintenance of systems.

This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for GES any liability in connection with the sales of our products other than that set forth herein.

NOTE: Due to on-going product development, GES reserves the right to change specifications without notice and will assume no responsibility for any costs as a result of modifications.

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